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SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R,S), MAY 2024
ROBOTICS AND AUTOMATION
(2020 SCHEME)

Course Code : 20RBT306

Course Name: Signals and Systems

PART A

(Answer all questions. Each question carries 3 marks)

1. Sketch the signal x(t)=-2u(0.5t+2).
2. Find the even and odd components of the signal $x(t)=1+2t+3t^2+4t^3$.
3. Find the Fourier transform of unit step signal.
4. Determine the Nyquist rate for the following signals
   (i) x(t)=2 sinc(100πt) (ii)x(t)=10 sin40πt cos300πt.
5. Using the properties of Z transform find the Z transform of the following signals
   (i) x(n)=u(-n+1) (ii) $2(3)^n u(-n)$.
6. State and prove differentiation in frequency domain property of DTFT.
7. Consider x(n)={1,2,-3,0,1,-1,4,2} with 8 point DFT. Evaluate the following values of X(K) without computing DFT
   (i)X(0) (ii)X(4).
8. Determine the output response y(n) if x(n)= {1,2,3,1} and h(n)={1,1,1}.
9. Draw the basic butterfly diagram of DFT algorithm.
10. Differentiate between FIR and IIR filter.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Check the following systems are (i)static or dynamic (ii)Linear or nonlinear (iii)causal or non-causal (iv)Time-invariant or time variant (9)
    (i)y(n)=x(n)x(n-2) (ii)$y(n)=a^n u(n)$.
    b) Determine whether the following signals are energy signals or power signal and calculate their energy or power (5)
    (i)$x(t)=\sin^2\omega t$ (ii)x(t)=tu(t).

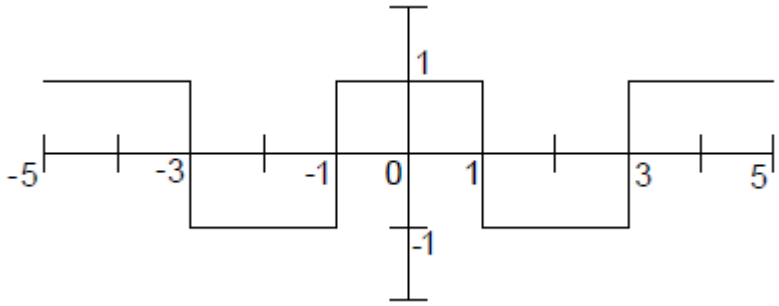
OR

12. a) Find whether the following systems are stable or not (6)
    (i)$h(t)=(2+e^{-3t})u(t)$ (ii)y(n)=x(n)+0.5x(n-1)+0.25x(n-2).

b) Examine whether the following signals are periodic or not? If periodic determine the fundamental period (8)
(i)sin 12πt (ii)3u(t)+2 sin 2t (iii)3 sin 200πt +4 cos100t
(iv) $\cos(\frac{n}{6})\cos(\frac{n\pi}{6})$ (v)$\sin\frac{2\pi n}{3}+\cos\frac{2\pi n}{5}$.

MODULE II

13. a) Obtain the trigonometric Fourier series for the wave form shown in the below figure. (9)



b) State and Prove Parseval's relation. (5)

OR

14. a) State and prove sampling theorem for low pass signal. (9)
b) Find the Fourier transform of the following (5)
(i) $te^{-at}u(t)$ (ii)cos $\omega_o t$ u(t).

MODULE III

15. a) Find the Z-transform and ROC of the following signals (9)
(i) $x(n)=(\frac{1}{2})^n u(n-2)$ (ii) $a^n u(n)-b^n u(n-1)$.
b) Write the properties of ROC. (5)

OR

16. a) Consider a discrete time LTI system with impulse response $h(n)=(1/2)^n u(n)$. Use Discrete Time Fourier Transform(DTFT) to determine the response to the signal $x(n)=(3/4)^n u(n)$. (9)
b) Using the properties of DTFT find the DTFT of the following. (5)
(i)u(n+1)-u(n-2) (ii)n 3^{-n} u(-n).

MODULE IV

17. a) Find the output of the sequence for the given h(n) and x(n) using overlap save method (9)
x(n)={1,2,-1,2,3,-2,-3,-1,1,1,2,-1} h(n)={1,2}.
b) Find the circular convolution of the sequence $x_1(n)$={1,-1,-2,3,-1} $x_2(n)$={1,2,3}. (5)

OR

18. a) Compute the 8-point DFT of the sequence given below (10)
x(n)=1 0≤n≤3

0 $4 \leq n \leq 7$.

b) Find the IDFT of Y(K)={1,0,1,0}. (4)

MODULE V

19. a) Find the DFT of the give sequence x(n) using DIT algorithm. x(n)= {1,2,3,4,4,3,2,1}. (10)

b) Draw the direct form structure of the FIR system described by the transfer function (4)

$H(z)=1+\frac{1}{2}z^{-1}+\frac{3}{8}z^{-2}+\frac{5}{4}z^{-3}+\frac{1}{2}z^{-4}+\frac{7}{8}z^{-5}$.

OR

20. a) Obtain the direct form I,II of the IIR system described by the difference equation (10)

$y(n)=-\frac{3}{8}\,y(n-1)+\frac{3}{32}\,y(n-2)+\frac{1}{64}\,y(n-3)+x(n)+3x(n-1)+2x(n-2)$.

b) Obtain the IDFT of the following sequence X(K)={6,-2+2j,-2,-2-2j} using DIF algorithm. (4)